The Beaver Lake Monitor

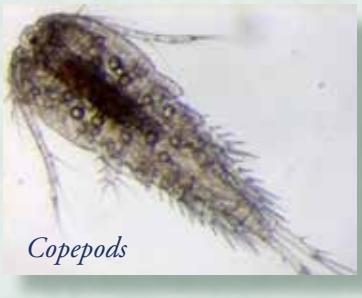
A publication of the Beaver Lake Management District Advisory Board

http://www.sammamish.us/projects/BLMD.aspx • Volume 16, Issue 2 • Summer 2015

Part 12 of the Series: Living With Wildlife

Zooplankton: Cladocera and Copepods

If you were to scoop some water from Beaver Lake into a white container and look very, very closely, you would likely see some tiny organisms swimming about. You might assume that these are small insect larvae or even mobile algae colonies, when in fact, they may be crustaceans that make up a large part of the zooplankton in lakes!



Copepods

Zooplankton are tiny animals that live suspended in the water column in both freshwater and marine environments. The most common types of zooplankton in lakes belong to the class Crustacea, and are distantly related to crabs and shrimps. The two most abundant zooplankton groups found in freshwater lakes are called copepods and cladocerans.

Some types of cladocerans are called "water fleas" because of their appearance. Their soft bodies are covered in a transparent shell called a carapace. The most common genus of cladoceran is Daphnia. Daphnia swim using their large second antennae, which look like giant feathered arms under the microscope. They can also be seen by the naked eye, moving about in the water in a unique, jerking fashion. Cladocera eat algae, microscopic animals, and organic debris. Food particles are filtered from the water using hairs on their five pairs of legs. The food moves along a groove on the underside of the body, and into the mouth. In turn, cladocera are eaten in great numbers by fish.

Cladoceran

Almost all Daphnia are female and can produce young quickly, without needing males for the process. Male Daphnia generally develop only in stressful conditions, and eggs produced from sexual reproduction look different and are made to last for long periods, only developing when good conditions return. In some lakes, this happens every year, while in others it happens only rarely.

Copepods are largely characterized by their two prominent first antennae, and their different body shapes. There are three major types: Harpacticoid (with the shortest antennae), Cyclopoid, and Calanoid (with the longest antennae). Copepods are good swimmers and move with short, rapid movements through the water, though they will occasionally cling to vegetation. Most copepods are herbivores, feeding on algae and protozoans. However, some are carnivorous and prey on other zooplankton. Copepods are raptorial; they seize food particles rather than filtering them out of the water. Like cladocera, copepods also serve as food for larger animals.

Copepods have approximately equal numbers of males and females, and they have a reproductive history that is similar to most other animals.

Zooplankton are an extremely important link of the food web in lake ecosystems. They can control algae abundance, keeping it from becoming a nuisance. In mesotrophic lakes, with intermediate productivity, zooplankton can remove a large portion of the algal community through feeding. In fact, a healthy community of zooplankton can impact the entire volume of a lake in a matter of days!

Story continued on page 6

Photos courtesy of Arni Litt from the UW College of Fisheries

Thanks to Retiring Beaver LMD Board Members!

The City of Sammamish and the Beaver Lake Management District would like to extend their sincere thanks to former Board members Ben Harrison and Michael Pamintuan, both of whom found it necessary to resign recently. Their services were highly appreciated, and the District wishes them well in the future.

Water Quality Update Winter 2015

The Beaver Lake Management District (BLMD) tracks water quality in Beaver Lake and the inlet creeks draining the watershed. Inlet sampling starts in the fall when the creeks begin to flow and ends in late spring as the creeks dry out, including both routine and storm samples. These data help the BLMD Advisory Board and the City of Sammamish identify management strategies and restoration priorities. For reminders on what we measure and why, as well as information on the charts, please see the summer 2014 issue.

Sample Locations

Bltri1 (Beaver tributary #1) enters the northern lake basin. It flows directly from the wetland north of East Beaver Lake Drive, and receives storm runoff during rain events.

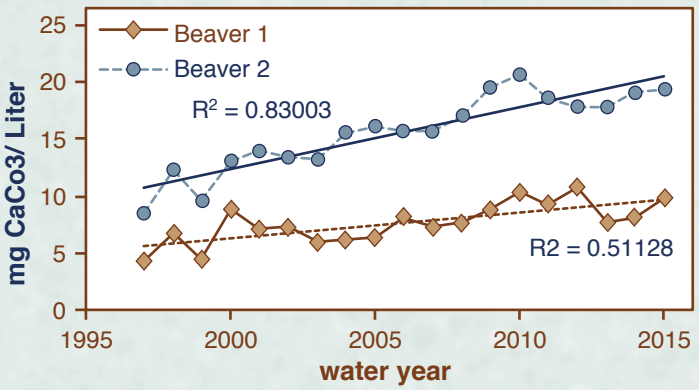
Bltri2 (Beaver tributary #2) flows from Hazel Wolf wetland through several other wetlands to the large middle lake basin. It is 0.75 miles long, draining a larger area that includes several residential developments and larger parcels.

Water quality trends with 2015 values added

Total alkalinity

Total alkalinity measures the "softness" of the water, referring to the amount of chemical resistance in the water to pH change. BLtri1 water is softer than BLtri2, due to the bog it drains and the small, less developed character of its watershed.

Mean total alkalinity, Dec-Mar

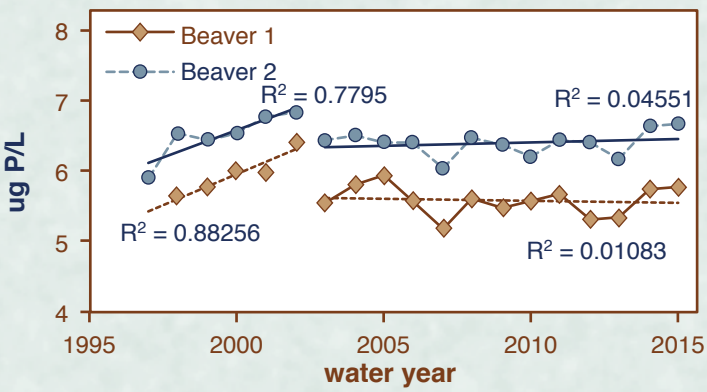


Increases in total alkalinity are often found as development proceeds due to disturbance and changes in the soils with development, as well as salts contained in urban runoff from both construction and ongoing residential activities. This can be seen in the progressive increase in alkalinity over time in both inlets, which have strong statistical relationships. The smaller increase in BLtri1 over time could be from increased road traffic and inputs from nearby detention ponds northeast of Beaver Lake. It could also indicate that changes are beginning to occur in the large wetland upstream.

pH

Changes in pH can be mitigated by total alkalinity, which is also called buffering capacity. BLtri2 is higher in alkalinity and more likely to resist change. Sphagum bogs generally have pH values near 5, so the low pH of BLtri1 reflects the large contribution of the bog to the inlet.

Mean pH Dec-Mar

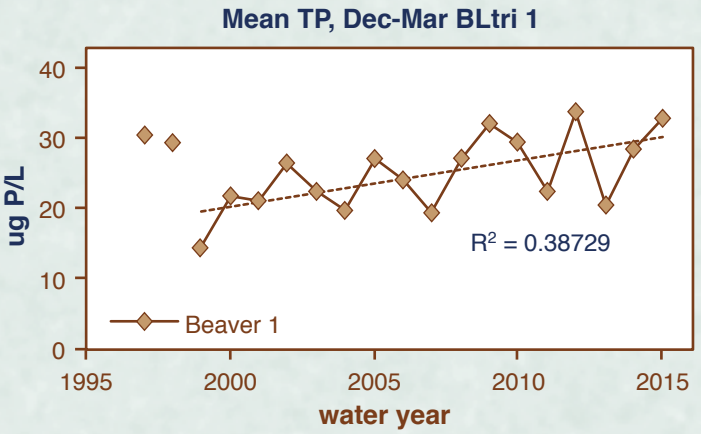


Although pH steadily increased in both inlet streams between 1997 and 2002, it has remained steady in both streams since then, with year-to-year changes that reflect annual variability. Low R^2 values often accompany trend lines drawn through data with no directional change. Why the shift may have occurred for both streams in 2003 is not readily explained, but the difference appears to be greater for Bltri1 than for BLtri2.

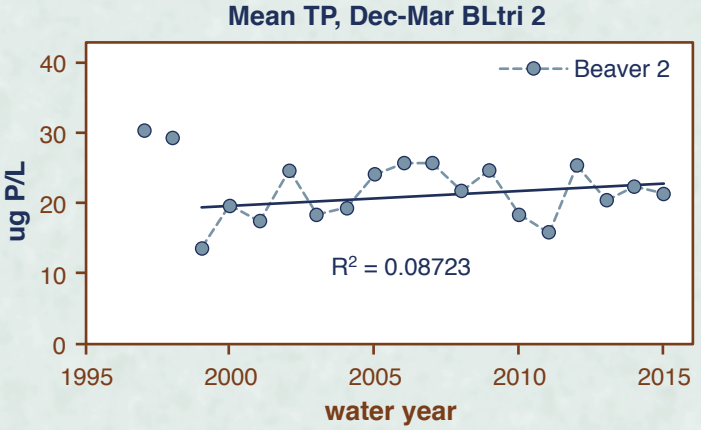
Total phosphorus

Winter phosphorus concentrations in both inlets dropped to a minimum in 1999 from the 1997 and 1998 levels. In 2015, phosphorus in BLtri1 increased from the 2014 average, while in BLtri2 it remained approximately the same.

BLtri1 has been slowly increasing since the drop in 1999, although it is highly variable from year to year. Since 2008, 6 of the 8 winter averages have been approximately equal to the values found in 1997-1998.

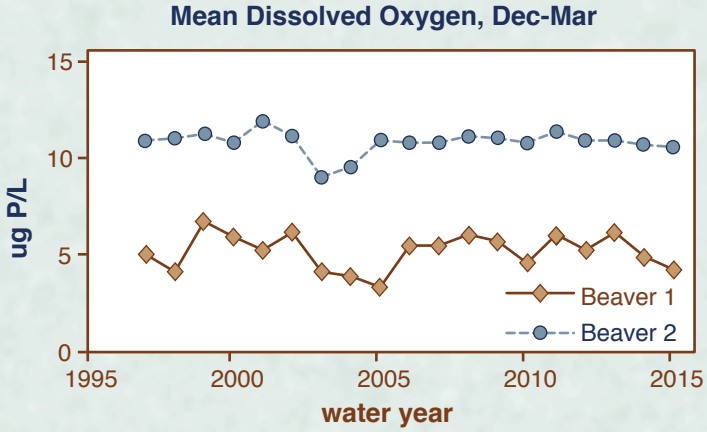


Total phosphorus concentrations in BLtri2 appear to be somewhat more stable over time with little evidence for an increasing trend in BLtri2. Unlike BLtri1, the average winter phosphorus content in BLtri2 has not returned to the 1997-1998 levels.



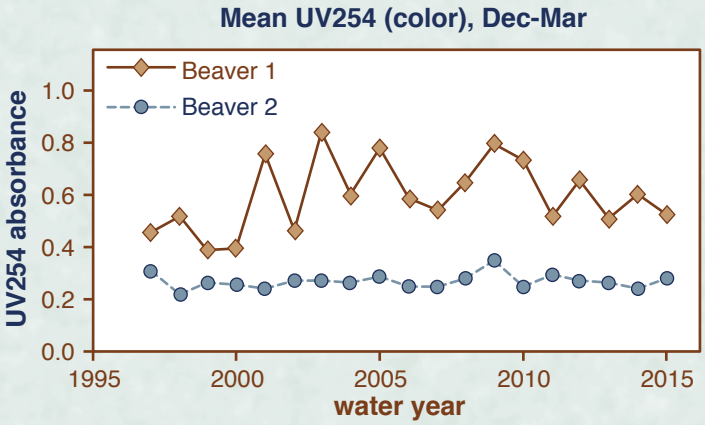
Water color and oxygen

Water color as measured by light passage at an ultraviolet frequency (UV 254) can used to estimate dissolved organic matter in the water due to incomplete decomposition. Because bacteria need oxygen in order to decompose organic matter, the amount of oxygen available can be a limiting factor.



BLtri1 largely contains outflow from the wetland that contains little oxygen in the bog mat, and it consistently has less oxygen dissolved in the water than BLtri2. A trend line drawn through the years does not produce any trend of note for either inlet.

BLtri1 also has significantly more color than BLtri2, which reflects the limited decomposition that can take place in the wetland. However, it is more variable between years because storm flows can contribute directly to the inlet from road runoff.



Conclusions on 2015 inlet monitoring

To-date, current stormwater regulations appear to protect Beaver Lake water quality. There is little evidence of increasing trends in total phosphorus concentrations in the Beaver Lake inlets, although BLtri1 may be increasing slowly over time. Alkalinity continues to increase in BLtri2 with development in the watershed, but also appears to be increasing slowly in BLtri1. Water color appears to be remaining steady in both streams, but there are fluctuations in BLtri1 likely related to flow, while water color in BLtri2 is very stable.

The possibility of an increase in phosphorus contributions from the wetland that feeds Beaver-1 should be taken very seriously and watched over the next few years. Wetlands hold very large amounts of nutrients in their bog mats and, if they begin to degrade, can quickly change from storing nutrients and organic matter to exporting nutrients, which could impact the lake negatively in the future.

Monitoring water quality in wetland ELS21

Wetland ELS21 at the head of the BLtri1 inlet exerts a major influence on water quality of the north basin of Beaver Lake. Because a final phase of land development has begun along the east and north sides of the wetland, the BLMD Advisory Board recommended monitoring the storm water inputs to the wetland buffer and outflow from the wetland on a

Story Continued on Page 6

The Watershed Savvy Garden: Part 2: Habitat Diversity

The gardens around our homes can never be exact copies of nature, but we can design and maintain our spaces to provide more reliable and suitable shelter, food, and space for all of the animals that live around us.

Planning a garden for hosting and helping your animal neighbors provides many human benefits as well. It provides opportunities for your family to enjoy watching the animals nearby and learn about their lives. It can build community relations when you and your neighbors collaborate along property lines to increase available habitat and provide corridors for wildlife to move safely through the area. Even a small amount of planting can increase the value of your property by increasing the visual interest around your home and providing some habitat for birds. And as a final benefit, providing and maintaining habitat diversity around your house can be both healthy and fun!

When you design for wildlife, it's best to make sure your high-use areas, such as patios, sports courts or lawns, and utility locations, are well away from the area where you would like to attract wildlife. Generally, home owners will choose to plant wildlife areas along property lines in places that are easily viewed from house windows. If your backyard neighbor wants to do the same thing, you can double the space available for the animals!

The element most often missing from areas around residences is a water source. If you live on Beaver Lake or by one of the tributaries, you have this built in and ready to go. Other ways of providing water include birdbaths and fountains. All animals need to drink water, while many birds need to bathe to keep their feathers clean and parasite free. Amphibians need to keep their skins moist, while both they and dragonflies need water for reproduction as well. Unfortunately, so do mosquitos, but they can be controlled by washing out the container and filling with fresh water once a week to get rid of their larvae.

Food can also be limiting for many wildlife. Lawns tend to attract few species, such as geese, robins, starlings, and deer. To increase the variety of animals on your property, increase the types of plants you grow to include tall grasses, perennials that hold their seeds, and shrubs that provide fruits or cones. Flowering plants with lots of nectar or pollen will also attract many kinds of birds, who may also feast on the local insects.

A key concept is to plant lots of different varieties to provide many kinds of foods. While native plants are ideal, as the animals in our area are adapted to them, many ornamental plants can also provide food and shelter. However, be sure you are not planting the next noxious weed, such as ivy or holly. It is best to check the King County noxious weed list to see what plants have run amok in our county and make sure you don't encourage them.

The need for shelter, refuge, and space to move can be different for each animal species. Your garden can be thought of as four layers going up into the air, with each layer attractive to different creatures. An ideal planting for habitat diversity should consist of all 4 layers to give the maximum benefit to wildlife.

The bottom or ground layer includes lawns, groundcovers and shorter plants that can harbor small mammals, insects, and snails or slugs. Although we often consider some of these as pests, they are food items for other animals, such as owls and hawks, raccoons, and even coyotes. Low growing plants generally do not provide much refuge, so a garden that is dominated by lawn or low ground covers may be more attractive to

pests than species desirable from a human standpoint.

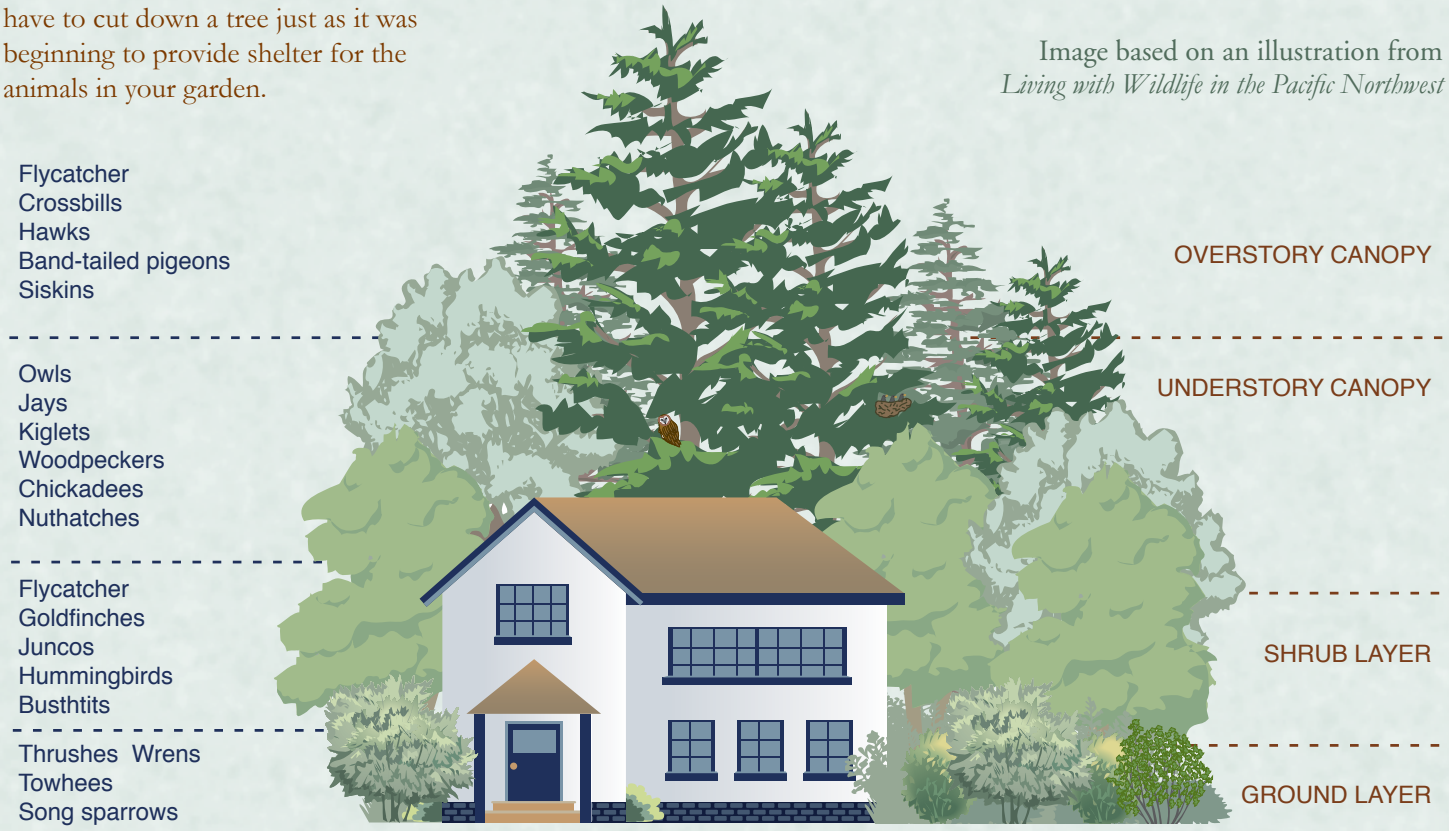
The next three layers all provide food, shelter and space for reproduction to species of birds and mammals, depending on their requirements. Birds in particular can use all 4 layers, but particular species will most likely be found in a preferred layer.

Perennials and ornamental grasses are the layer above ground covers, and these are most heavily used by smaller animals, such as rabbits, rodents, and squirrels, as well as amphibians and reptiles. The next higher layer, which consists of shrubs and small trees, are very heavily used by both birds and mammals, but less so by amphibians and reptiles, which generally prefer being closer to the ground. The highest layer consists of tall trees, which also provide food and shelter, but which also protect the lower three layers from weather impacts, such as wind storms or hot temperatures due to direct sunshine. Be sure to site tall trees in an area that does not threaten your house if they drop branches during a storm. It would be sad to have to cut down a tree just as it was beginning to provide shelter for the animals in your garden.

The University of Washington Press and the Washington Department of Fish and Wildlife has published two books on this subject that contain many good ideas on how to go about diversifying your property for wildlife benefits. Both are by Russell Link, with the titles *Landscaping for Wildlife in the Pacific Northwest* and *Living with Wildlife in the Pacific Northwest*. Information on these books can be found on-line by searching "Washington" plus the book titles.

Another book that contains good information on native species and how to use them in your garden is entitled, *Gardening with Native Plants of the Pacific Northwest* by Art Kruckeberg , also published by the University of Washington Press.

Image based on an illustration from *Living with Wildlife in the Pacific Northwest*



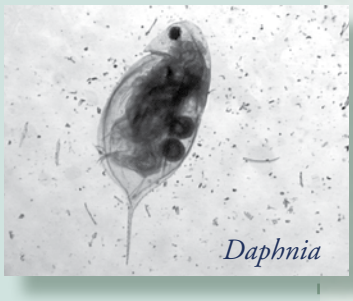
Part 12 of the Series: Living With Wildlife Zooplankton: Cladocera and Copepods

Continued from page 1

In addition to feasting on algae, zooplankton are a necessary source of nutrition for planktivorous fish, which depend on thriving populations of zooplankton to survive. Fish will actually hunt for the largest individuals to eat.

Bosmina

Zooplankters don't just float around waiting to be eaten, however. Many species can move up and down in the water column in response to light intensity, in order to avoid being seen by predators.



Daphnia

We can catch fish or see them swimming in the water, and we also can see algae when it blooms or forms scums or floating mats. But because of their inconspicuous presence, zooplankton are not often recognized for the indispensable role they play in keeping fish healthy, or algae populations under control. There are many species of zooplankton, each with unique features and interesting characteristics.

Water Quality Update Winter 2015

(Continued from Page 6)

routine basis to complement the storm samples taken by the developer as part of the development permit. Water Year 2015 marked the beginning of this monitoring, which includes the same parameters that are measured by the consultant to the developer.

Station ELS21-1 is located at the outlet from the stormwater detention pond along the eastern side of the wetland area that flows to the buffer of the wetland. This water does not flow directly to the open water area of the wetland, but rather is diffused to soils in the outer buffer area. BLtri1a is located upstream from BLtri1, so that measurements are made of water coming directly from the wetland without the addition of road runoff.

Samples were taken monthly at the two stations concurrently with the inlets sampling. Values from December through March were averaged, similar to the data shown for the inlets, but because there is just one year of data, the values are presented in tabular form.

Dec 2014-Mar 2015	ELS21-1	BLtri1a	Units of Measure
Total Alkalinity	43.2	9.5	mg/L CaCO3
UV254	0.110	0.524	absorbance
Ammonia	0.004	0.013	mg/L N
Nitrate-nitrite	0.144	0.037	mg/L N
phosphate	0.0037	0.0089	mg/L P
Total Phosphorus	0.0228	0.0510	mg/L P
Turbidity	7.71	7.29	NTU
Temperature	7.1	4.9	degC
Oxygen	6.84	3.77	mg/L
Specific Conductivity	99.5	31.9	umhos/cm at 25 degC
pH	6.62	5.98	pH units

Water flowing from the wetland is much lower in both specific conductivity and total alkalinity than the urban stormwater exiting the pond, which is consistent with known effects of urbanization. The pH is also lower, in the range for sphagnum bogs. Temperature is considerably lower as well. The wetland outflow has more color and less dissolved oxygen, both factors that relate to decomposition of organic material.

All of the nitrogen and phosphorus compounds are higher coming from the wetland than in the water from the detention pond, with the exception of nitrate-nitrite, which is related to the lower availability of oxygen in the wetland.

These values will act as a baseline for comparison over time as development proceeds and stormwater flows into the wetland. Another pond is slated to be developed to the north and west of the current facility, and upon completion the outflow will also be monitored for water quality.

From Watershed Wetlands and Streams into Beaver Lake:
The Natural Beauty of Keeping Water Clean

Hazel Wolf Wetland

Deep Soils Filter Water

Outlet from Hazel Wolf Wetland

Tributary 1

High Quality Bog North of Beaver Lake

Outlet from the Bog

King County

Department of
Natural Resources and Parks
Water and Land Resources Division
201 S. Jackson Street, Suite 600
Seattle, WA 98104

PRESORTED
STANDARD
U.S. Postage
PAID
Seattle, WA
Permit No. 6013

Address Service Requested

City of Sammamish

The Beaver Lake Monitor
Summer 2015

Duplicate mailings? Change of address?

Call us at 206-477-4800 or send mailing label, with the correct address, clearly marked, to the above address. Please allow 6-8 weeks for changes.

Alternative Formats Available Upon Request.

Beaver Lake Management District Board seeking volunteer members

There are currently two vacancies on Beaver Lake Management District Advisory Board.

The Advisory Board of the BLMD evaluates projects and programs for importance and consistency with the LMD Resolution, based on current conditions and the overarching goals of the LMD. Once the work program is determined, the City of Sammamish, acting upon the advice of the LMD Board, manages the work, as well as the LMD budget.

To be eligible for appointment to the board you must be a current tax district member living inside the LMD boundaries. If you are interested in applying for a position on the Beaver Lake Management District Board please go to http://www.sammamish.us/projects/BLMD.aspx#Members for information on how to apply or contact Melonie Anderson, City Clerk, at manderson@sammamish.us. If you do not receive a response within five days or you have questions, please call (425) 295-0511.

The Beaver Lake Monitor
The Beaver Lake Monitor is published by the Beaver Lake Management District Advisory Board with the assistance of King County Water and Land Resources Division.

LMD Advisory Board:
Joe McConnell.....**jdbeaver20@comcast.net**
Frank Blau.....**fjblau@gmail.com**

Newsletter staff:
Editor.....**Sally Abella**
Contributing writers.....**Sally Abella, Chris Knutson, Rachael Gravon, Evan Maxim**
Layout.....**Megann Devine**

Contact:
Sally Abella, Lake Stewardship Program,
King County Department of Natural Resources and Parks
201 South Jackson Street, Suite 600, Seattle WA, 98104

Email: **sally.abella@kingcounty.gov**
Phone: **206-477-4605**
Beaver Lake Community Club - **www.beaverlake.org**
City of Sammamish - **www.sammamish.us**

Printed on recycled paper. Please recycle. 1202M
1506_4870m_BeavLkMon-summer2015.indd